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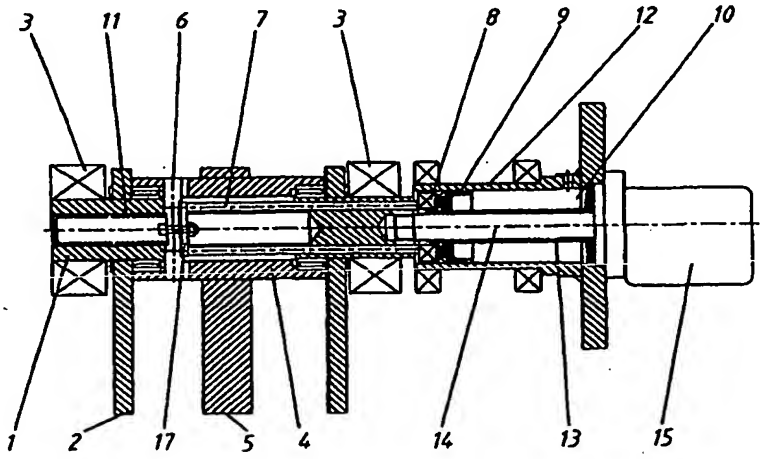
(54) Title: ROTATABLE ECCENTRIC DEVICE




(57) Abstract

The present invention relates to a rotatable eccentric element for continuous adjustment of the vibration amplitude in the roll of vibrating rollers. In particular, the invention relates to a rotatable eccentric arranged in a roll of a vibrating roller with a drive means (26) for thr roll arranged at one end of the same, which eccentric arrangement is adapted for stepless adjustment of the vibration amplitude. The arrangement comprises a rotatable shaft (1, 14) extending in the centre of the roll with at least one eccentric weight (2) arranged in a fixed manner thereon and at least one movable weight (5) which is pivotable relative to the fixed weight between a position with maximum amplitude and a position with minimum amplitude for changing the vibration amplitude of the arrangement, means for converting an axial movement into said pivoting in a radial plane, and also a displacement arrangement for providing said axial movement arranged in that part of the roll opposite the drive means. The arrangement is characterized in that the displacement arrangement and the means for converting an axial movement into a pivoting movement are located at a distance from one another and are interconnected via at least one rod (7, 23) which is axially displaceable parallel to the rotatable shaft (1, 14).

# ROTATABLE ECCENTRIC DEVICE

## Technical field

The present invention relates to a rotatable eccentric element for continuous adjustment of the vibration amplitude in the roll in vibrating rollers. In particular, the invention relates to a rotatable eccentric arrangement adapted for stepless adjustment of the vibration amplitude, comprising a rotatable shaft with an eccentric weight arranged in a fixed manner thereon and a movable weight which is pivotable relative to the fixed weight between a position with maximum amplitude and a position with minimum amplitude for changing the vibration amplitude of the arrangement, means for converting an axial movement into said pivoting in a radial plane, and also a piston arrangement for providing said axial movement.

## Background

In the packing of earth, asphalt or similar material using vibrating rollers, the best packing effect is obtained initially if the amplitude is high. After the material has been hard-packed, however, the roll starts to move irregularly and bounce on the surface. This impairs the packing and leads moreover to great stresses on the roller. By reducing the amplitude, this is avoided and the degree of packing can be increased further. This regulation can be effected using electronics and hydraulics, under the control of a packing meter mounted on the roller, which continuously measures the firmness (degree of packing) of the surface. Such an arrangement for continuous adjustment of vibration amplitude is described in, for example, SE 443 591. In this and similar known constructions for vibrating rollers, the vibrations are generated by an eccentric which is mounted in the

centre of the roll. In most cases, the eccentric is driven by a hydraulic motor on one side of the roll. On the other side, in the roll centre, there is in most cases a slow-running hydraulic motor with high torque or a planetary gear with a fast-running hydraulic motor for propulsion of the roller. Parts of these are connected to the roll via rubber elements and rotate with the roll. This makes it difficult and impractical to carry out any regulation inside the roll from this side, and constructions in which this is done are often complicated and have poor durability. On the other side, as already mentioned, the drive motor for the rotation of the eccentric is usually located. In the specification referred to above, the regulation of eccentric elements is brought about on this side by virtue of the eccentric motor driving a splined shaft which is moreover displaceable and constitutes the piston rod or the extension thereof in a hydraulic piston arrangement. However, this previously known arrangement is complicated to produce. Moreover, it is a disadvantage that the splined shaft also transmits the torque to the eccentric arrangement, and that a great frictional force is therefore produced, which has to be overcome when the axial displacement takes place.

It is also desirable to be able to assess and determine the bearing life because this normally varies greatly depending on use. This is due to the fact that the centrifugal force increases with the frequency and the amplitude, and the life of the bearings is dependent on the centrifugal force and the frequency.

During asphalt packing, the rolls should not vibrate when the roller is at a standstill or changing its direction of travel. The rollers on the market stop the rotation of the eccentric element before the roller stops or changes the direction of travel. If the eccentric element is started and stopped when the amplitude is great, the result is a resonant frequency with undesirable vibrations as a consequence. It is therefore desirable to be able to start the rotation of

the eccentric element essentially without amplitude and to be able to provide the amplitude at the desired frequency, that is to say the desired speed of rotation. It is also desirable to be able to adjust to zero amplitude even with full frequency.

The object of the invention

It is therefore an object of the present invention to provide a rotatable eccentric arrangement of the type indicated in the introduction, with a more durable and safer construction than in previously known designs.

This object is achieved by means of an arrangement according to the appended patent claims.

Brief description of the drawings

In the appended drawings,

Fig. 1a shows a cross-sectional view of a roll in a vibrating roller with a rotatable eccentric arrangement according to a first embodiment of the invention;

Fig. 1b shows the same view as in Fig. 1a but with only the eccentric arrangement being shown;

Fig. 2 shows the eccentric arrangement according to Fig. 1 in the position for maximum amplitude, seen on the one hand in cross section from the side and on the other hand in the axial direction;

Fig. 3 shows the eccentric arrangement according to Fig. 1 in the position for minimum amplitude, seen on the one hand in cross section from the side and on the other hand in the axial direction;

Fig. 4 shows a cross-sectional view of a second embodiment of an eccentric arrangement according to the invention;

Fig. 5 shows a third embodiment of an eccentric arrangement according to the invention in the position for minimum amplitude, seen in cross section from the side;

Fig. 6 shows a fourth embodiment of an eccentric arrangement according to the invention in the position for maximum amplitude, seen on the one hand in cross section from the side and on the other hand in the axial direction, and

Fig. 7 shows an eccentric arrangement according to Fig. 6 in the position for minimum amplitude, seen on the one hand in cross section from the side and on the other hand in the axial direction.

Description of preferred embodiments

The invention will now, for the purpose of exemplification, be described in greater detail by means of a preferred exemplary embodiment. The invention comprises a rotatable eccentric arrangement with steplessly adjustable imbalance.

A preferred embodiment of the invention, as shown in Figs 1-3, comprises a shaft 1 which is rotatably mounted in two rotary bearings 3. On the shaft 1, there is a tube 4 with a movable eccentric weight 5 which is pivotable in relation to the shaft 1 and fixed weights 2 arranged thereon, so as to make adjustment of the vibration amplitude possible. This pivoting of the movable weight is obtained by displacing a pin 6 in an axial slot in the shaft 1 and at the same time by means of the ends in a helical slot in the tube 4. In this way, an axial displacement of the pin 6 will be converted into a rotation of the movable weight in a radial plane relative to the shaft 1. However, it is of course possible instead to make the slot in the shaft helical, or for both slots to be helical but have different pitch. By means of the pivoting, the weights interact with or counteract one another and increase or, as the case may be, decrease the imbalance depending on the direction in which the rotation takes place.

According to the invention, the displacement of the pin 6 is brought about by one, two or even more axially displaceable rods 7 which run in a

corresponding number of holes adapted for this purpose in the shaft 1. The rods are preferably arranged symmetrically around the centre line of the shaft 1 and, in this embodiment, two such rods are arranged on opposite sides of the centre line of the shaft 1. The rods are arranged between means for bringing about a pivoting of the movable weight 5, that is to say in this case the pin 6, and means for bringing about an axial displacement. In this connection, the rods are preferably not loaded by the torque which is used to rotate the eccentric. In this way, the frictional forces which arise if the displacement is instead brought about by the rotary shaft 14 are avoided.

The rods are preferably connected to one of the sides of a rotary bearing 8 and, in this embodiment, are connected to the inner ring of the rotary bearing 8. However, it is nevertheless possible of course to connect the rods to the outer ring of the bearing.

The other side of the bearing, that is to say the outer ring in this case, is connected to the displacement means, in this case a hydraulic cylinder 9, which is arranged on the same side as the drive means 15 for the rotation of the eccentric, and opposite the side with the planetary gear 25 for propulsion of the roller. The piston runs in the interspace inside an outer tube 12 and outside an inner tube 13 arranged therein. The shaft 14 which connects the drive means 15 and the eccentric shaft 1 rotates inside the tube 13. By pumping oil into the chamber 10, the non-rotating piston 9 can be caused to be displaced, the force being transmitted to the rotating pin 6 which in turn causes the various eccentric weights to rotate in relation to one another by means of the axial or, as the case may be, the helical slot.

If the chamber 10 is connected to a tank, the piston 9 can be drawn back with the force which is required in order to rotate the weights 5. If appropriate, the restoring force can be supplemented or replaced by a spring 11. The spring ensures that the

imbalance (the amplitude) can be reduced to zero and retains the tube 4 with the weights 5 in this position when the shaft is at a standstill. This means that the rotation of the shaft can be started without amplitude, that is to say with the movable weight in the position for minimum amplitude, as shown in Fig. 3. As an alternative, a spring-loaded catch 26 can retain the weight in the zero position. The catch is thrown out and released by the centrifugal force at a given threshold frequency, after which the desired regulation can take place. However, other retaining means which are released at a given force or a given frequency are also possible.

In order to reduce the requirement for manufacturing accuracy, the pressure from the rods 7 can be transmitted via a yoke 17 to the centre of the pin 6. The yoke 19 can also be designed as a plate spring and can then be screwed firmly to the pin 6. The yoke prevents the pin 6 from rotating about its axis and also holds it in the centre of the shaft 1.

In a second exemplary embodiment of the invention, as shown in Fig. 4, the displacement of the pin 6 is brought about by virtue of a second pin 21 being arranged inside the inner ring 22 of the rotary bearing 8. This pin 21 is displaceable in an axial slot in the drive shaft 20 and is furthermore connected to a rod 23 extending in the centre of the drive shaft 1 as far as the pin 6. In other respects, this embodiment corresponds to that described previously.

Furthermore, in this second exemplary embodiment, the displacement means is an electric actuating device instead of a hydraulic piston. This electric actuating device functions as a worm gear screw which, by interacting with an external thread of an inner displaceable tube, exerts a displacing force against the bearing 8. Displacement means other than those indicated above are of course also possible.

Fig. 5 shows a third exemplary embodiment of the invention. In this case, the single-acting cylinder

and the spring have been replaced by a double-acting cylinder which consequently has twin chambers and can impart axial displacement forces in both directions. The direction of rotation of the shaft 1 is then optional. If appropriate, the single-acting cylinder may be designed so that the tube 24 is a part of the piston.

Finally, Figs 6 and 7 show a third embodiment according to the invention, in which the pivoting axis of the movable weight 5 has been displaced from the centre of rotation of the shaft 1 towards the centre of gravity of the fixed weights 2. If the weight 5 has a common centre of rotation with the shaft, it will adopt a position which produces minimum amplitude. By displacing the centre of rotation of the weight 5 towards the centre of gravity of the fixed weights, this force is reduced, and if it is displaced even further, the force will instead be directed in the opposite direction. Without pressure to the piston, the weight will then adopt the position with maximum amplitude, as shown in Fig. 6. If oil is pumped into the chamber 10, the weights will be rotated in relation to one another and be rotated towards the position with minimum amplitude, as shown in Fig. 7. By pressurizing the chamber on starting and stopping, the eccentric element can be started and stopped with minimum amplitude or without amplitude. Impact originating from the weight 5 can then be avoided.

In certain cases, such as cases with a double-acting cylinder or an electric actuating device, it may instead be desirable for the displacement to be only so great that the forces are essentially minimized.

Control of the weights in a suitable manner in order to obtain the correct amplitude and/or frequency can advantageously be effected automatically by means of an electronic or digital control unit which can be fed an input signal from a packing meter or the like.

The invention has now been described with reference to a number of exemplary embodiments.

However, other variants of the invention are of course possible. For example, it is possible to use one or more fixed weights, one or more movable weights etc. Such and other closely-related variants must be considered to be covered by the invention as defined by the appended patent claims.

## PATENT CLAIMS

1. Rotatable eccentric arrangement arranged in a roll of a vibrating roller with a drive means (15) for the eccentric arranged at one end of the roll, which eccentric arrangement is adapted for stepless adjustment of the vibration amplitude and comprises a rotatable shaft (1, 14) extending in the centre of the roll with at least one eccentric weight (2) arranged in a fixed manner thereon and at least one movable weight (5) which is pivotable relative to the fixed weight between a position with maximum amplitude and a position with minimum amplitude for changing the vibration amplitude of the arrangement, means for converting an axial movement into said pivoting in a radial plane, and also a displacement arrangement for providing said axial movement arranged on the same side of the roll as the drive means (15), characterized in that the displacement arrangement and the means for converting an axial movement into a pivoting movement are located at a distance from one another and are interconnected via at least one rod (7, 23) which is axially displaceable parallel to the rotatable shaft (1, 14).

2. Rotatable eccentric arrangement according to Patent Claim 1, characterized in that the means for converting the axial movement into a pivoting movement comprises a pin (6) which is displaceable in but extends essentially transversely to the shaft direction and is displaceable in axial slots with different pitch, on the one hand of the rotatable shaft and on the other hand of a tubular part (4) of the movable weight (5), which part is arranged rotatably around the shaft, the pin being interconnected with the displaceable rod (7, 23).

3. Rotatable eccentric arrangement according to Patent Claim 2, characterized in that a yoke (17) which balances on an edge (18) is arranged on the pin (6), which yoke receives the force from the displacement arrangement so as to distribute the pressure uniformly against the pin.

4. Rotatable eccentric arrangement according to any one of the preceding patent claims, characterized in that the displacement arrangement is arranged at the side of and preferably around the rotatable shaft (14).

5. Rotatable eccentric arrangement according to any one of the preceding patent claims, characterized in that the displacement arrangement acts against one side of a rotary bearing (8) and the displaceable rod is interconnected with the other side of the same bearing.

6. Rotatable eccentric arrangement according to any one of the preceding patent claims, characterized in that the fixed and the movable weight have the same eccentric mass, and in that the movable weight can be guided into a position in which the weights essentially balance one another so that the amplitude is essentially zero.

7. Rotatable eccentric arrangement according to any one of the preceding patent claims, characterized in that a spring (11) is arranged so that it acts so as to guide the movable weight (5) so that the amplitude decreases, and so as to ensure that the arrangement has minimum amplitude when the rotation is started.

8. Rotatable eccentric arrangement according to any one of the preceding patent claims, characterized in that the displacement arrangement comprises a piston arrangement, and preferably a hydraulic piston.

9. Rotatable eccentric arrangement according to any one of the preceding patent claims, characterized by a control means adapted to control the amplitude according to the frequency (the speed of rotation) or vice versa so that the stress on the bearings is essentially constant.

10. Rotatable eccentric arrangement according to any one of the preceding patent claims, characterized in that the centre of rotation of the movable weight (5) is displaced towards the centre of gravity of the fixed weight (2).

11. Rotatable eccentric arrangement according to any one of the preceding patent claims, also comprising a retaining means (26) arranged to retain the movable weight in the position with minimum amplitude, which retaining means is adapted to be released by the centrifugal force at a given threshold frequency.

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/01257

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: E01C 19/28
According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: E01C, E02D, B06B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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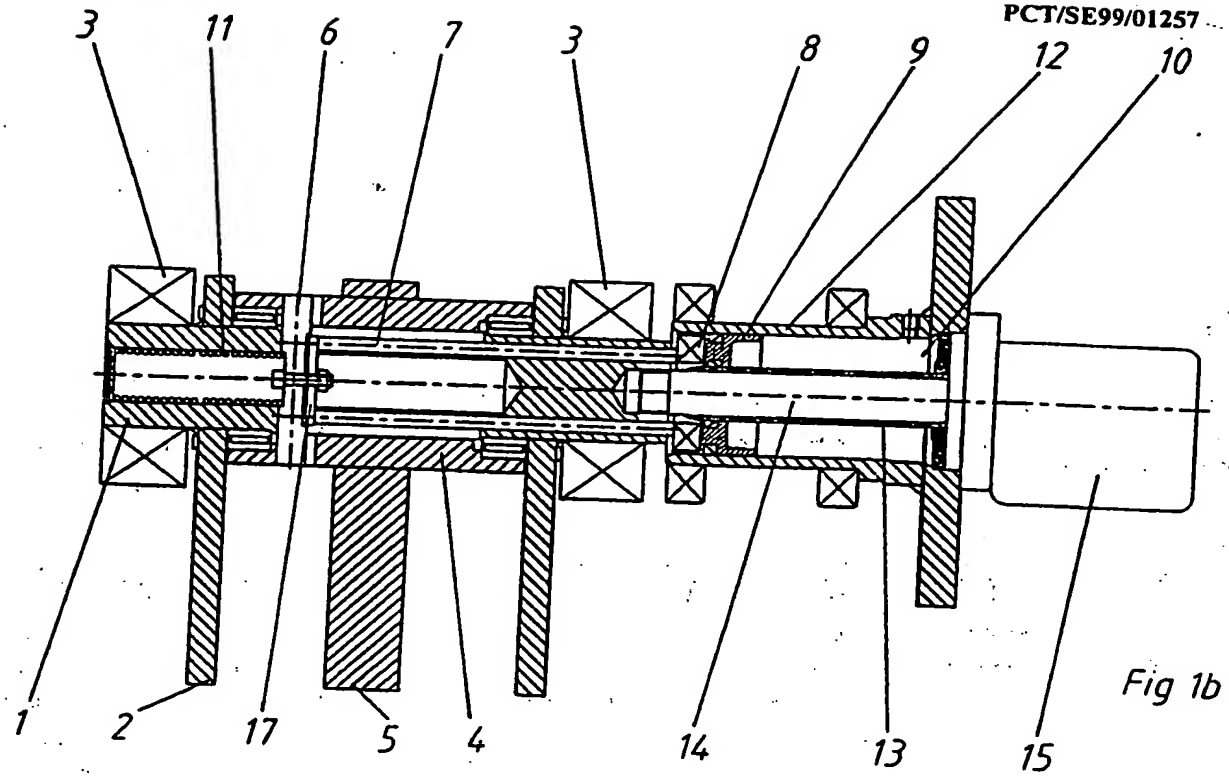



Fig 1b

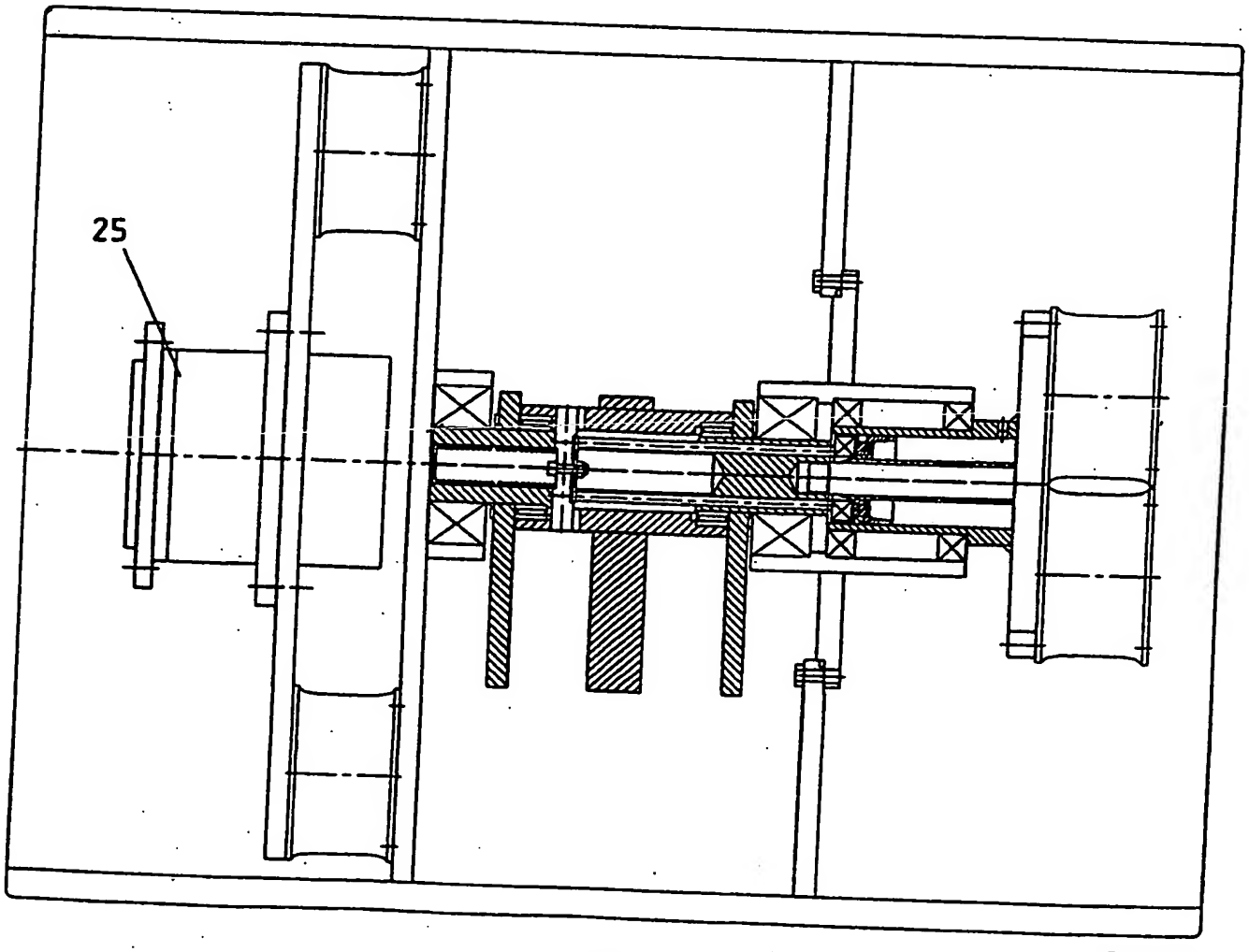
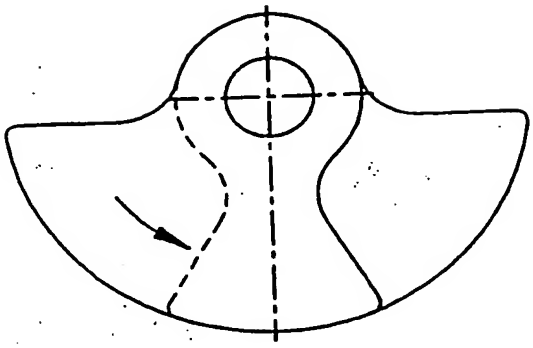



Fig 1a



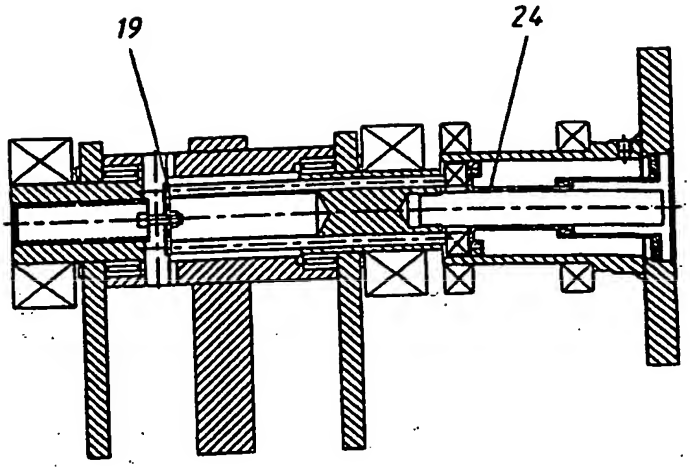
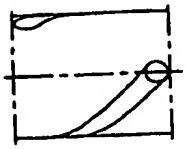
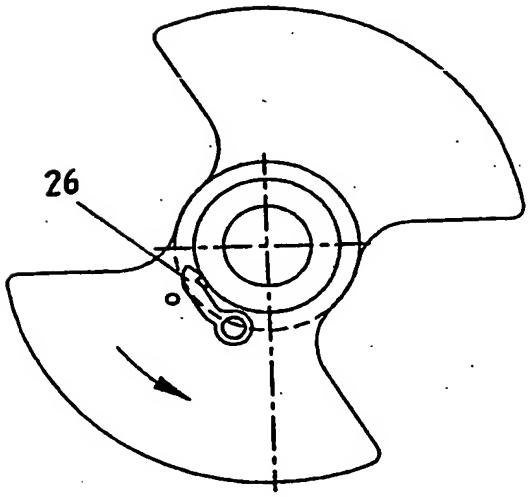



Fig 2





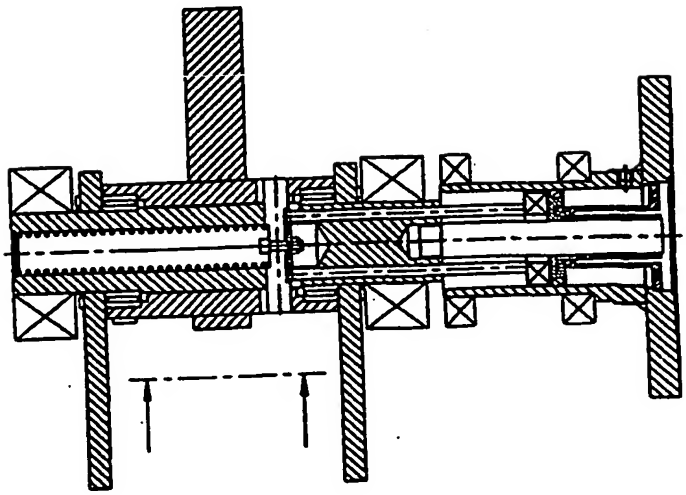



Fig 3

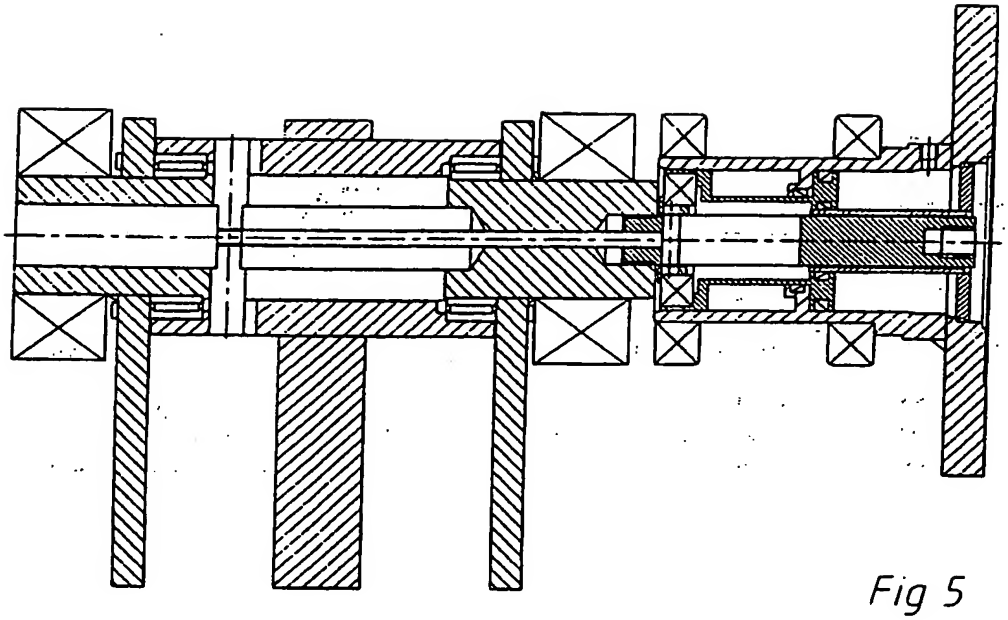


Fig 5

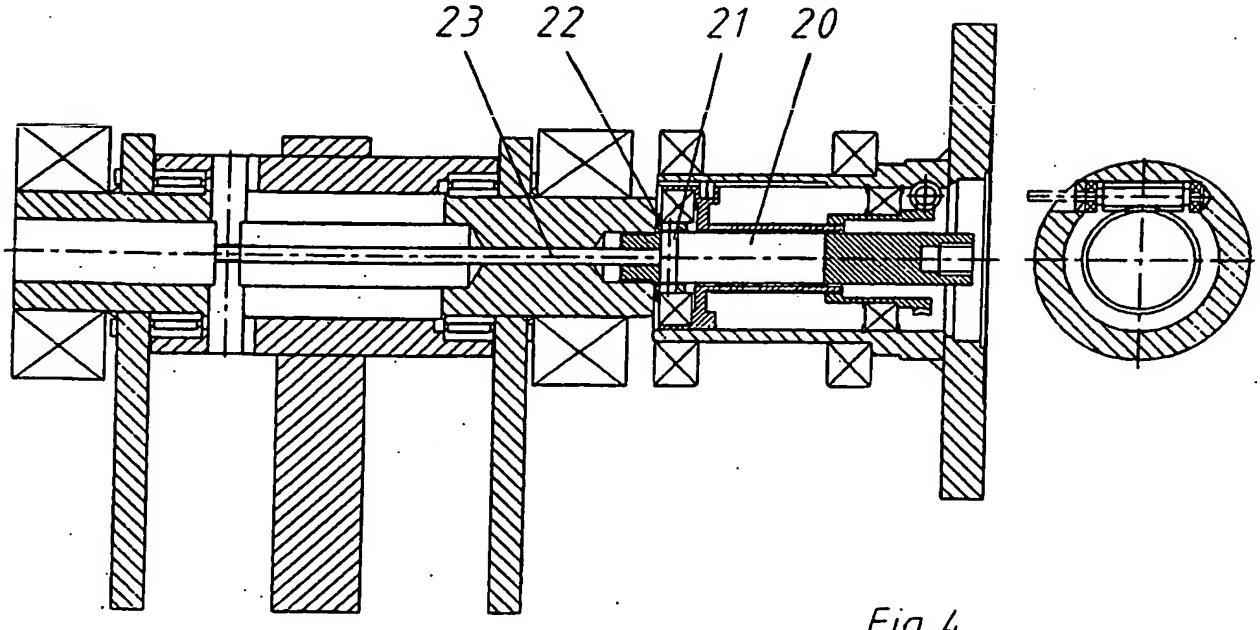



Fig 4

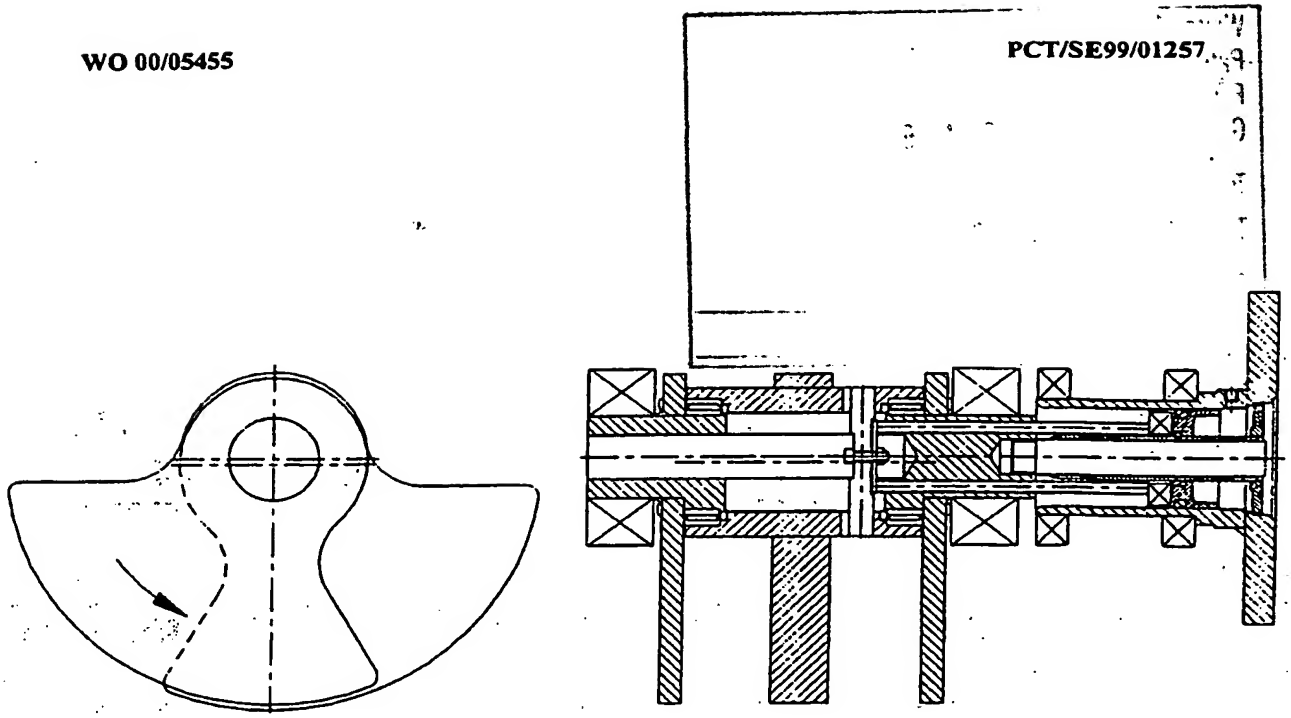


Fig 6

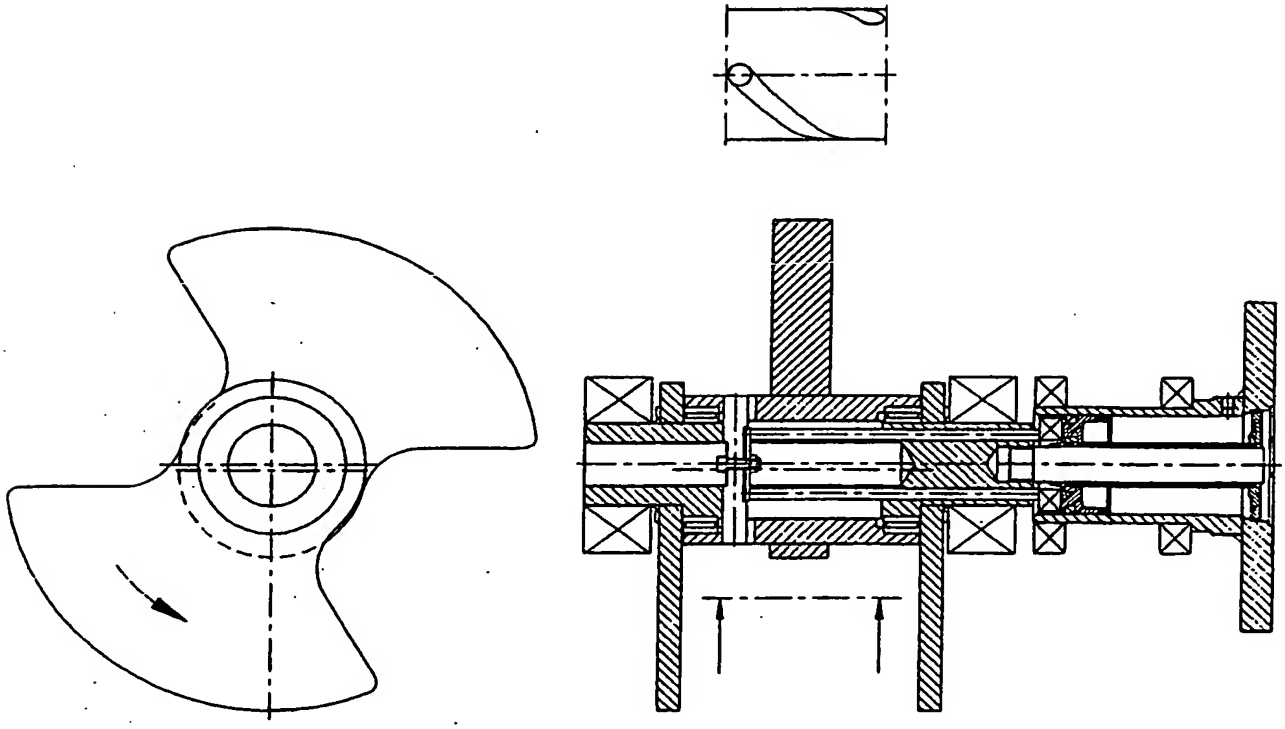


Fig 7